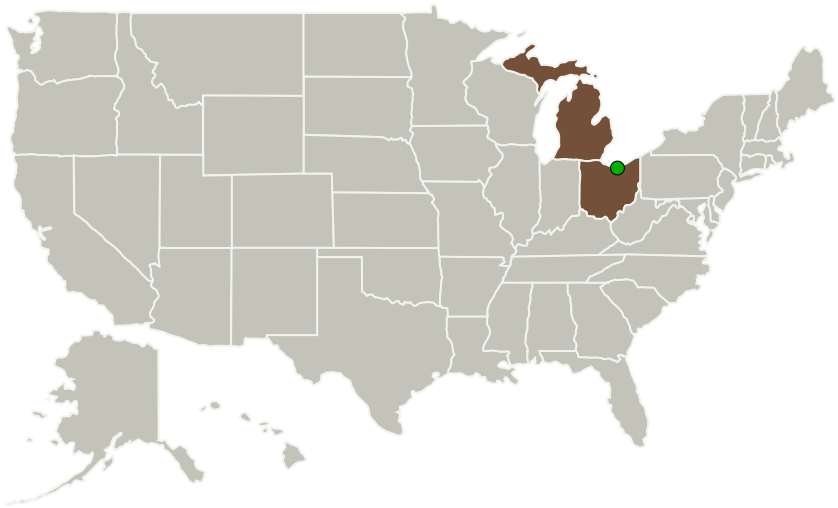
# Low Cost Resin for Self-Healing High Temperature Fiber Reinforced Polymer Matrix Composites, Phase I

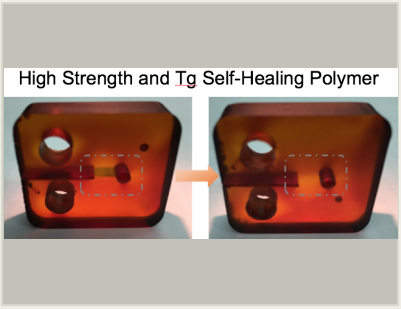
Completed Technology Project (2017 - 2017)

## Project Introduction

Over the past few decades, the manufacturing processes and our knowledge base for predicting the bulk mechanical response of fiber reinforced composite materials has matured and opened the capability to design lightweight materials. The rapid development and progress of composites technology has been spawned by the high specific strength, stiffness, and toughness offered with respect to other engineering materials. However, the performance of a composite material is heavily influenced by the strength and toughness of the polymer matrix, which binds the high stiffness fibers into a cohesive element. Unfortunately, the highly cross-linked polymers necessary to achieve the high Tg required by propulsion systems are costly and prone to brittle fracture under even small elastic deformations. While the rigidity of the polymer is required for practical applications, the lack of resistance to crack propagation leads to damage prone materials. This proposed SBIR will develop a new low cost self-healing thermosetting polymer which exhibit high Tg (>550 F), high strength, stiffness and toughness from a room temperature low viscosity resin that allows processing without heating the polymer. The self-healing properties of polymer will yield increased reliability of the composite and reduced maintenance costs. HARP Engineering will formulate a polymer that meets or exceeds both the performance and cost metrics required by NASA through the use of multifunctional self-healing resins. This Phase I will perform mechanical testing of the resin at elevated temperatures and layup composites for ASTM testing to demonstrate the high specific strength, stiffness, and toughness compared to existing high temperature resins.

## Primary U.S. Work Locations and Key Partners






Low Cost Resin for Self-Healing High Temperature Fiber Reinforced Polymer Matrix Composites, Phase I Briefing Chart Image

## Table of Contents

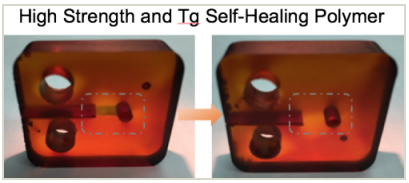
# Low Cost Resin for Self-Healing High Temperature Fiber Reinforced Polymer Matrix Composites, Phase I

Completed Technology Project (2017 - 2017)

| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| HARP Engineering, LLC | Lead Organization | Industry | Ann Arbor, Michigan |
| Glenn Research Center(GRC) | Supporting Organization | NASA Center | Cleveland, Ohio |

| Primary U.S. Work Locations | |
|---|---|
| Michigan | Ohio |

## Images




**Briefing Chart Image**
Low Cost Resin for Self-Healing High Temperature Fiber Reinforced Polymer Matrix Composites, Phase I Briefing Chart Image *(https://techport.nasa.gov/image/134603)*

## Organizational Responsibility

**Responsible Mission Directorate:**
Space Technology Mission Directorate (STMD)

**Lead Organization:**
HARP Engineering, LLC

**Responsible Program:**
Small Business Innovation Research/Small Business Tech Transfer

## Project Management

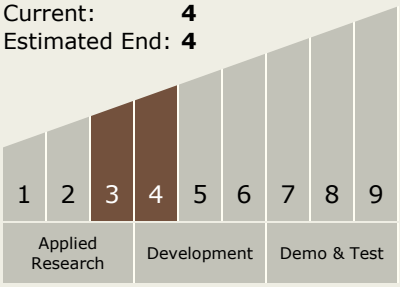
**Program Director:**
Jason L Kessler

**Program Manager:**
Carlos Torrez

**Principal Investigator:**
Timothy Shankwitz

## Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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## Technology Areas

**Primary:**

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.1 Materials
    - TX12.1.1 Lightweight Structural Materials

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System